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WOOD DESIGN & BUILDING®

WINTER 2020-21 — NUMBER 87

THE MODULAR REVOLUTION

SoLo
An award-winning Passive House prototype

Hotel Bauhofstrasse
Modular mass timber in Europe

Katerra Case Study
The Catalyst Building's design innovation

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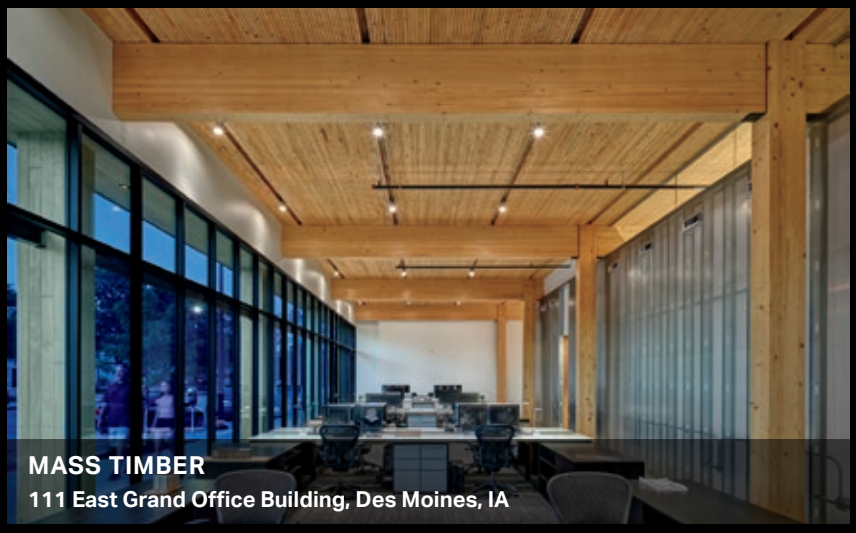
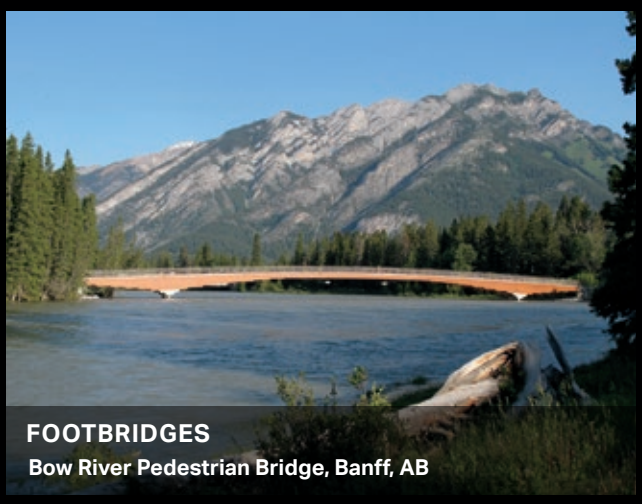


MASS TIMBER
111 East Grand Office Building, Des Moines, IA

CUSTOM ARCHITECTURAL
Tsingtao Pearl Visitor Centre, China

LONG-SPAN
University of Idaho Basketball Arena, Moscow, ID



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Above and **on the cover:** This will be the first project to implement the Model-C modular system developed by Boston-based firm Generate, working with Placetailor
IMAGE: Forbes Massie Studio

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The Future Might Be Modular

Few of us were sad to see 2020 end, except for regretting the many events that were postponed or cancelled. In our case, the yearly *Wood Design & Building* Awards – which are usually the focus of our Winter issue – were moved from fall to early 2021. The Spring/Summer issue will include the winners. One of the featured projects in this issue, SoLo (on p.18), won a Merit award, and while the full details can't be shared at this time, this Passive House residence is serving as a prototype for the development of Canada's Earth Tower, in Vancouver. By the architect's description, some of the tower's mass timber components could end up being modular.

When mass timber meets modular construction, the results seem to hit a sweet spot. This issue features a variety of projects that are exploring modular solutions, but if space allowed, many more could have been included. Although modular buildings have a fairly long (and not necessarily acclaimed) history, a new generation of architects and designers is exploring wood's potential for better, more efficient factory-built structures. Using modular elements – often with utility services, windows and doors already installed – speeds up construction by minimizing weather-related delays and onsite requirements, including equipment and labor.

Modular solutions are especially appealing for affordable housing and hospitality projects. The Hotel Bauhofstrasse (on p.27), in Germany, is one of many international hotels that are utilizing modular elements. A few of those were featured in the Fall 2020 issue (*Hospitality Works with Wood*). In this issue, "A Modular Revolution" (on p.32) looks at the global movement and how wood is playing a starring role, while "Wood Chips" includes other news about modular mass timber construction.

It's an exciting time for the industry, and for this magazine, which is celebrating its 30th anniversary in 2021. As we look ahead to the next 30 years, massive change is already underway. A healthier, cleaner and "greener" planet has become a bigger priority than ever, and mass timber's role in the global recovery is crucial. Plus, quite simply: Wood looks good.

Popi Bowman
Managing Editor

Wood Design & Building magazine invites you to submit your project for consideration and possible publication. We welcome contributed projects, bylined articles and letters to the editor, as well as comments or suggestions for improving our magazine. Please send your submissions to pbowman@dvtail.com.

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WHAT I'VE FALLEN FOR LATELY...

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WOMEN IN ARCHITECTURE, PART 2

In the Fall 2020 issue, we highlighted some of the women in Canada who are excelling in this industry, which is well known for being male-dominated. Of course, we couldn't include all of them in the first column – and as we add to the list, it seems to keep growing:

Caroline Caskey: Now semi-retired, the co-founder of TEAL Architects in Halifax worked as a registered nurse before completing a Master of Architecture at Dalhousie University in 2004.

Wendy Crowe: The project architect and construction administrator for Lubor Trubka Associates Architects was part of the team that produced the award-winning Kwakiutl Wagalus School in B.C.

Aimee Drmic: The LEED-accredited senior architect has worked with Perkins&Will since 2006.

Susan Fitzgerald: The architect received the Canada Council's $50,000 Prix de Rome in 2011. She is a partner/principal at the award-winning Halifax firm, FBM.

Julie Frappier: The engineer is director of technical services at Nordic Structures, in Quebec.

Karla Fraser: The director of construction for Hive Projects and Cape Group, in Vancouver, won the Wood *WORKS!* Technologist Award in 2018 for her achievements working on the groundbreaking, 18-storey UBC Brock Commons project.

Susan Gushe: The managing director and a principal at the Perkins&Will headquarters in Vancouver is also part of the team behind plans for Canada's Earth Tower. One of her favorite past projects is the Nicola Valley Institute of Technology, a post-secondary institution for five Indigenous bands; the building won a Governor General's Medal, among other awards.

Kathleen Kurtin: Launching her independent practice in the 1980s, Kurtin's eponymous firm distinguished itself by specializing in renovation within Toronto's downtown core. The firm also provided the foundation for the City of Toronto's Live/Work guidelines. After several years of involvement, Kurtin became Ontario Association of Architects (OAA) Council president in 2019, to be replaced by Susan Speigel in 2021 (see below).

Dr. Nancy Mackin: Often working closely with Indigenous communities, Vancouver-based Mackin Tanaka Architecture was established in 2000 and has won several awards.

Vouli Mamfredis: With more than 35 years of experience, the LEED-accredited architect is co-founder of Montreal's Studio MMA, which emphasizes sustainable design. Mamfredis is an expert panelist/advisor on sustainable design.

Vivian Manasc: A member of the Alberta Order of Excellence and co-founder of the award-winning Edmonton firm Manasc Isaac Architects (now Reimagine Architects), she also co-founded the Alberta Sustainable Building Symposium and participated in the founding of the Canada Green Building Council. The firm's portfolio includes many well-known mass timber structures, including numerous Indigenous projects. One of several other women at the firm, Métis architect/artist **Tiffany Shaw-Collinge** received a Master of Architecture from the Southern California Institute of Architecture (SCI-Arc).

Marianne McKenna: A founding member of KPMB Architects, McKenna is an Officer of the Order of Canada recognized for her contributions to creating "architecture that enriches the public experience" and she was named one of Canada's Top 100 Most Powerful Women by the *Financial Post*. Other women in the firm include **Judith Taylor** (principal and LEED-accredited project manager) and **Lucy Timbers** (senior associate/project architect).

Eladia Smoke: The first female First Nations architect in Ontario and Manitoba, in 2014 Smoke established her eponymous firm in Hamilton, Ontario. She has served on the RAIC's Indigenous Task Force since its inception, and Smoke was part of the international team of designers who contributed to the 2018 Venice Biennale "Unceded" exhibition, led by Douglas Cardinal. She is also a master lecturer at Laurentian's McEwen School of Architecture.

Susan Speigel: The current president of the OAA established her multidisciplinary firm, SSA Studio, in 1993. Much of her work has focused on social housing, including more than 250 projects for the Toronto Community Housing Corporation.

To be continued...

ABBIES 2020 Award Winner

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Prefab(ulous) Backyard Escapes

Abigail Cukier

A bright spot for many families during the COVID-19 pandemic has been spending more time together. But sometimes, so much togetherness can feel, well, like *too much* togetherness. With the recent trend of working from home, there may be plenty of days when you need a nearby escape. Here are four companies whose wood-based modular designs are backyard-ready.

Business developer Wilson Edgar and architect Michael Leckie founded **The Backcountry Hut Company (BHC)** in 2015 to create a simple structure that could be installed in almost any location. The B.C.-based company works with locally sourced, sustainably produced materials and aims to supply 100 percent recyclable systems. The BHC's four modular systems range in size from 107 to 3,000 sq.ft., including a freestanding sauna, two-storey cabin and single-storey cabin with loft. Its A-frame shelter is 10x10 at ground level with an optional loft space above – think single bedroom, yoga space, art studio or office. Designed to be assembled by a team of four or five DIYers in less than a week, the system comes shipped prefabricated and flat packed. Features include Douglas fir glulam decking and floor panels, a custom corrugated metal roof and double-pane windows. It also can accommodate electrical, water and sewer service.

California-based Plant Prefab designs and builds custom modular, prefabricated single- and multi-family homes. Unlike panelized systems, such as SIPs (structural insulated panels), which only incorporate framing and insulation, the company's "Plant Building System" uses specialized panels that include plumbing, electrical and finish materials. They can be used on their own or assembled into "Plant Modules" for kitchens, baths or mechanical rooms. Plant Prefab recently collaborated with Minnesota company Alchemy Architects to create the **lightHouse LivingHome** series of accessory dwelling units (ADUs), which range in size from 310 to 600 sq.ft. and include features like window nooks that double as seating, and finish options that adapt to different climates. Plant Prefab constructs its units in an indoor facility, building the walls, floors and ceilings on jigs. Most units arrive 90 percent complete and are installed in a single day. Founded by Steve Glenn in 2016, the company has committed to fully carbon-neutral operations by 2028.

After living in Norway, Koto Design co-founders Johnathon and Zoë Little fell in love with the country's aesthetic and environment. Koto, which means "cozy at home" in Finnish, was founded in January 2018 and has offices in North Devon, England, and Belfast, Northern Ireland. Inspired by Scandinavian design and culture, the couple teamed with Koto co-founder Theo Dales to create modular homes, cabins and sculptural small buildings. Koto delivers complete, architect-designed, energy-neutral buildings to site. Its home office model, **Work Space Cabin**, was created in partnership with the New Art Centre gallery. The natural, carbon-neutral design includes one huge window and slanted walls. The cabin's timber walls are charred using the Japanese process of shou sugi ban, to protect wood from weathering.

Japanese brand MUJI, best known for its household goods, apparel and food, released its **MUJI Hut** in 2017. A strong raft foundation guards against ground moisture, while the interior area of the cabin spans just under 100 sq.ft. With a high shed roof and sliding glass door that opens onto a 32-sq.ft. covered veranda, the company says the space is large enough for three to four people to comfortably relax in. MUJI Hut also uses the shou sugi ban technique for its hardwood cladding; the traditional art of Japanese shipbuilding burned cedar to increase its resilience. The inner wall surfaces are left untreated. All of the wood used for the hut is sourced in Japan.


1


2


3


4

1. The Backcountry Hut Company
   thebackcountryhutcompany.com
2. lightHouse LivingHome
   plantprefab.com
3. Work Space Cabin
   kotodesign.co.uk
4. MUJI Hut
   muji.com/jp/mujihut/en.html

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WELCOMING *WOOD DESIGN & BUILDING*'S NEW PUBLISHER, AND CELEBRATING 30 YEARS OF THE MAGAZINE!

The editorial team is sad to see Etienne Lalonde retire after 28 years as the magazine's publisher (and VP of Market Development at the Canadian Wood Council), but we also are welcoming a new year with plenty of reasons to celebrate. The arrival of COVID vaccines is great news for everyone.

This year is *Wood Design & Building*'s 30th anniversary; the first edition – *Wood le bois*, at the time – was published in 1991. The magazine has changed dramatically over the years, and as mass timber goes mainstream, we are reaching a wider audience than ever. As a voting member of the International Award for Wood Architecture, representing North America, our voice is heard globally. We are keeping pace with a rapidly evolving industry, so we're planning some exciting new features in upcoming issues. Stay tuned!

We're also excited to welcome Andrew Bowerbank as incoming publisher of *Wood Design & Building*, and the new VP of Market Development at the Canadian Wood Council. He is a certified industrial designer, professor and published author with executive leadership experience in Canada's building, energy and infrastructure sectors, including as CEO of the World Green Building Council. Bowerbank was named one of Canada's top 16 sustainability leaders through the Clean50 Awards and received the Ontario Premier's Award for his career accomplishments.

After bidding adieu to 2020, it's exciting to share some good news. *Wood Design & Building* wishes everyone a happier and healthier 2021!

PROJECTS TO WATCH

In the most recent e-newsletter, we included a variety of projects:

Central Credit Union Arena, University of Idaho

- Two schools in Vancouver are being updated to seismic standards – by being replaced with mass timber structures. The B.C. government is investing $46.9M in the pilot project for future mass timber schools; additional funding was provided through Natural Resources Canada's GCWood Program.

- At the Mont Ste. Marie ski resort near Ottawa, a $4.5M CLT building with 15 short-term rental units is being planned for completion next spring.

- The new 4,200-seat Central Credit Union Arena at the University of Idaho is on schedule to open this summer. The arena is designed for LEED Silver certification, and will be the first wood facility of its size in the state.

- Outside Seattle, a two-storey building is nearing completion, the first mass timber commercial development of its scale in the area.

- Bjarke Ingels's one-million-sq.ft. campus for Google in California, using mass timber and featuring stepped green roofs, starts construction this year.

- The world's tallest mass timber tower will be the 25-storey Ascent mixed-use building, now under construction in Milwaukee. It is scheduled to open next year.

- In case you missed it (but how could you?): The Taiyuan Domes Botanical Garden completed last year in China features three long-span timber gridshells ranging in span from 140 to 300 ft. Covering more than 130,000 sq.ft. and using 11,000 pieces of glulam, with more than 250,000 fasteners, the design was "a significant structural challenge," according to StructureCraft.

Be sure to visit WoodDesignandBuilding.com to sign up for e-news.

MORE PROJECTS TO WATCH

CANADA

Featuring four new projects in British Columbia

- The new **Castlegar Chamber of Commerce and Visitor Centre** will be a $5M, 7,000-sq.ft. structure built to Passive House standards, designed by Cover Architectural Collaborative, a multidisciplinary firm based in nearby Nelson. Construction is expected to begin next year, with local supplier Kalesnikoff Lumber producing the mass timber. The Government of Canada is contributing $1.4M, with almost $1M from the province; the funding is part of the CleanBC Communities Fund, a partnership between the federal and provincial governments.

- In Vancouver, planning is underway for another Passive House project. **On5** is a four-storey building by Hemsworth Architecture (designers of the Upper Skeena Recreation Center, which was shortlisted for ArchDaily's 2021 Building of the Year). The On5's design will feature CLT shear wall panels and exterior walls which will be faced with rainscreen and cladding. The designers – working with Equilibrium Consulting, a Katerra company – also are investigating ways to pre-attach mechanical and electrical systems to the CLT, and the CLT floor panels will implement an innovative resin adhesive system for connections. The building utilizes the same seismic system used in the Fast + Epp Home Office (featured in the Fall 2020 issue): Tectonus hold-down devices, which were developed in New Zealand.

- Due to open this year, the **Malahat Skywalk**, on Vancouver Island, is a visitor attraction built of steel and Douglas fir glulam, rising 32 m to a platform where visitors can enjoy spectacular views. The development is a collaborative project with the local First Nation community.

- The 12-storey **Tresah building**, also on Vancouver Island, will be the largest mass timber multi-family structure in Canada; a livestream of the project can be viewed at tresah.ca. Developed by Mike Geric Construction – working with D'Ambrosio Architecture + Urbanism, RJC Engineers and Kinsol Timber Systems – the building is the first of its kind for Victoria, B.C.

UNITED STATES

- In Boston, the new 345,000-sq.ft. **Center for Computing & Data Sciences** will be the city's first building of its size to be carbon-free, targeting LEED Platinum certification. Designed by Canadian firm KPMB, completion is planned for next year.

- Houston's San Jacinto College is in the final stages of building the **Center for Engineering and Technology,** a three-storey, 122,000-sq.ft. mass timber structure by Kirksey Architecture. It is the nation's largest mass timber academic building on a college campus, with steel bracing for lateral support. Along with utilizing mass timber for the structural frame, shafts, floors and roof, the project includes a powerful gray water collection system and 30,000 sq.ft. of roof-supported photovoltaics.

UNITED STATES

- An office building expansion is the first large-scale use of modern mass timber in the District of Columbia. The 100,000-sq.ft. addition to **80 M Street SE** is designed by Hickok Cole in collaboration with Arup, comprising two storeys and a penthouse, plus a rooftop terrace and photovoltaic array, on top of the existing seven-storey concrete structure. The project is set to become the first high-rise overbuild timber structure in North America, and is targeting LEED Gold certification. As the first mass timber structure in D.C. to exceed 85 ft., Hickok Cole's design was carefully vetted by the code authority before earning approval. Arup's structural and fire engineers developed new concepts for 80 M's two-hour-rated exposed timber connections; these were further designed and tested by Katerra, the timber design-assist partner, with help from the Arup team.

- Above: In Columbia, S.C., a five-storey, 75,000-sq.ft. building developed by WestLawn and designed by Perkins&Will in collaboration with Robinson Gray Stepp & Laffitte, LLC, recently broke ground. It will be the state's largest mass timber office structure, and the city's first – part of the **BullStreet development**, the East Coast's largest urban redevelopment project. Completion is planned for early next year.

- Close to completion in Alaska, the 27,491-sq.ft. **Sitka Sound Cruise Terminal** features a mass timber structure produced by Canadian Timberframes in collaboration with Lignum Design, both located in Golden, B.C.

- In Denver, **Cirrus** is the first CLT multifamily project in the city, featuring 292 apartments comprising 286,787 sq.ft. Katerra is providing design, general contracting and material supply services, using CLT for five of the seven storeys. The panels are estimated to sequester more than 7,700 tons of CO_2, equivalent to the energy consumed by 890 homes in one year. Cirrus is aiming for LEED Silver certification.

- In Nashville, Hartshorne Plunkard Architecture, StructureCraft and DPR Construction are building the 190,000-sq.ft. **Nashville Warehouse Company Office**, which is the city's first large-scale mass timber project. The two office buildings, up to five storeys tall, are part of a larger mixed-use development. The floor and roof decks are DLT, supported by a glulam post and beam structure

Two other significant projects supplied by Katerra are currently under construction:

- The 100,000-sq.ft., four-storey **Fastenal Headquarters** in Winona, Minn., is scheduled for completion this fall, with architect of record The Kubala Washatko Architects (TKWA). Three-ply CLT is used for the floors and roof decking. The exterior's local stone and masonry facade reflects the historic charm of the town.

- In Midlothian, Va., **Artistry at Winterfield** is the first and largest apartment community in the area, with 15 individual three-storey buildings providing 200 residential units, totaling 210,000 sq.ft. Comprehensive amenities include more than 300 parking spaces, a fitness center, bike storage and dog wash/spa area. Occupation is expected this summer.

INTERNATIONAL

- At 800,000 sq.ft., the government-funded **Tianfu Agriculture Expo** in Chengdu, China, will be the largest mass timber structure in Asia – and one of the largest in the world – when it is completed this year. Working with Chinese architect CuiKai, StructureCraft developed the design for five exhibition halls using innovative, hybrid wood-steel Vierendeel trusses to achieve clear spans of more than 375 ft. and heights of 150 ft. CNC files were generated for each of more than 8,000 unique glulam pieces, produced by Hasslacher Norica Timber. The giant truss systems weighed in at more than 30 tons. In Canada, the StructureCraft team is using an advanced remote management system to provide real-time control of QC/QA on the site.

- A Stirling Prize winner and one of the founding signatories of the climate change action group Architects Declare, U.K. firm Feilden Clegg Bradley Studios is designing a six-storey, 60,000-sq.ft. CLT office building, **Paradise,** located in Vauxhall, London. The net-zero hybrid structure will be a combination of CLT, glulam and some supporting steel beams, on a concrete foundation.

- The recently announced **WoHo tower** in Berlin will be the world's tallest hybrid timber building, at 29 storeys. Norwegian architects mad arkitekter designed the mixed-use structure with a steel-reinforced concrete framework, but the majority of the structure will be wood.

MODULAR MANIA

Over the past few years, several of the wood buildings that have caught our attention were modular. Mentioned in our last issue, which focused on hospitality projects, the Hotel Jakarta by SeARCH Architects won a 2018 Architecture MasterPrize for Green Architecture. The climate-neutral luxury hotel is constructed of 176 room modules, with a load-bearing wood structure in addition to CLT walls and roof. This issue's feature, "A Modular Revolution" (p.32), takes a closer look at other notable projects around the world.

We also compiled a shortlist of more interesting companies that are exploring this realm.

- **Click Modular Homes:** Five wood-framed units – from a 510-sq.ft. micro-home to 1,100-sq.ft., three-bedroom bungalow – are produced by this B.C.-based company, starting at close to $150,000.

- **Pluspuu:** The Finnish design-build company has been producing modular, cabin-style prefabs since 2017. Fourteen models range in size from studio to four bedrooms, including two sauna structures. The houses are manufactured by Ollikaisen Hirsirakenne Oy, a traditional log house factory in southern Finland.

- **EcoHome/Écohabitation:** This Montreal-based company collaborates with well-known architects to create prefabricated home kits up to 2,310 sq.ft., with seven models that are designed to LEED and Passive House standards.

- **Drop Structures:** Five compact models built in Alberta, each with a Douglas fir main structure, are completely finished and "ready for plug and play." Baltic birch is used for interiors, with cedar decks in larger models. Starting at $27,800 to over $100,000, these units have become popular for resort destinations and remote locations; the total price includes delivery to anywhere in North America.

- **R-Hauz:** We recently spoke with co-founder Leith Moore about the company's first six-storey, all-wood mass timber building in Toronto, the R-Town Pilot apartment building. "Panelized is the new modular," Moore proclaimed. This CLT prototype is a "repeatable" mid-rise design that can be scaled to 20-, 40- or 60-foot-wide lots; the mass timber structure was assembled in less than six weeks, in conjunction with CMV Architects and Moses Engineering. R-Hauz is expanding quickly, with more than 20 new projects in planning.

"Against the Grain" also features some of our favorite compact modular units – perfect backyard studios for working from home.

A Prefabricated Country House

Factory-built modules create a luxurious, eco-friendly retreat

Following the purchase of a humble country house 25 years ago, the owners wanted to treat themselves to a new second home that would comfortably accommodate all the new members of their family. Overlooking Lake Manitou in Ivry-sur-le-Lac, Quebec, the home is composed of five factory-built modules, each approximately 50-ft. long, that were constructed before being shipped to their final destination. Designed by Canadian architect Richard Rubin from Figurr Architects Collective, the design was conceptualized with the vision of creating an extremely low environmental footprint. The architect/owner is in the process of applying for LEED Gold certification.

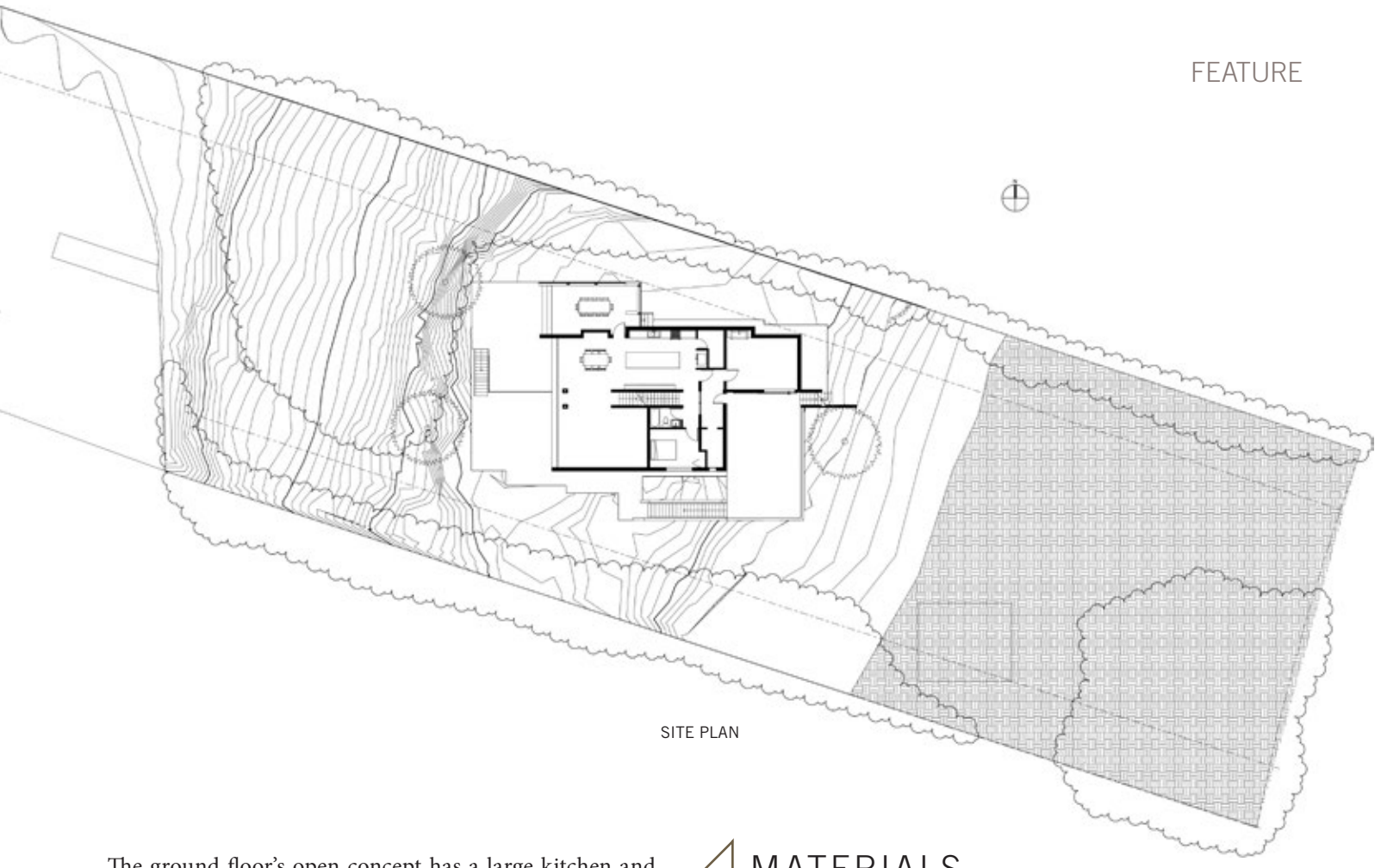
By building the modules in a factory environment, construction was completed under optimal working conditions. The prefabricated boxes are made completely of wood, with LVL columns and beams, wood I joists, 2x8-in. exterior wall studs, plywood sheathing, Maibec prefinished exterior wood siding and 2x2-in. horizontal cedar strip siding.

The modular design is unique, created according to precise plans by the architect. The insulation, windows and flooring were all installed before shipping. Transporting the giant modules proved to be quite a challenge. The process included preparation, coordination and navigating through country roads with 90-degree turns, a challenge that was compounded by inclement weather.

Construction began in late summer before the demolition of the existing house. This ensured a faster process so that the family would not lose more than one season enjoying the country.

To achieve a low environmental footprint, the house was built using sustainable and local materials. The large windows capture the beauty of the natural surroundings and flood the inside with light. The direct sunshine helps reduce both heating and lighting costs.

The natural-colored outdoor facade blends easily into the woodland decor, and the opaque black accents add an artistic flair. The wood used indoors is warm and welcoming, and the interior layout affords each family member their own personal space.



SITE PLAN

The ground floor's open concept has a large kitchen and dining area where everyone enjoys cooking and eating together, as well as a cozy living room and a three-season screened-in porch surrounded by lake and woods. The ground floor also has an atelier for painting and carpentry. The lowered lakeside deck was designed to preserve the view of the magnificent scenery. Overall, the gross built area – including the screen porch – is approximately 4,200 sq.ft.

As Rubin explains, "In our industry, we've been forced to adopt new technologies at an incredibly fast rate, and this has changed our profession drastically. Yet, sometimes we still dump a load of lumber on wet grass. There's a disconnect." By using a different approach to building his home, the architect is convinced that the future of construction will incorporate new ways of building. "Modular is the way of the future."

ARCHITECT
Figurr Architects Collective
Montreal, QC/Ottawa, ON

STRUCTURAL ENGINEER
Jeffrey Leibgott, SBSA
Saint-Laurent, QC

GENERAL CONTRACTOR
Norexco
Sainte-Agathe-des-Monts, QC

PHOTOGRAPHY
David Boyer
Montreal, QC

MATERIALS

Facade cladding
2-in. cedar stained lattice strips, black-stained real wood siding (Black #399 by Maibec)

Flooring
2x4-ft. ceramic tile, concrete textured by Stone Tile (ground floor); engineered wood, birch (upper + lower floor)

Doors
Shaker-style wood doors

Windows
Aluminum triple-glazed; living room aluminum curtain wall by Alumilex

Roofing
Two-part modified bitumen by Soprema

Kitchen
Suss Woodcraft

Built-in furniture
Russian yellow birch plywood

Deck and screen porch
Cedar posts and deck boards

Screen wall between kitchen and stairwell
2x6-in. clear pine, stained

Floating stairs and fireplace mantle
European Beech panel, BeauBuche

Interior lighting
LED pot lights by Globe Electric; suspended fixtures by Sonneman, Artemide

SoLo

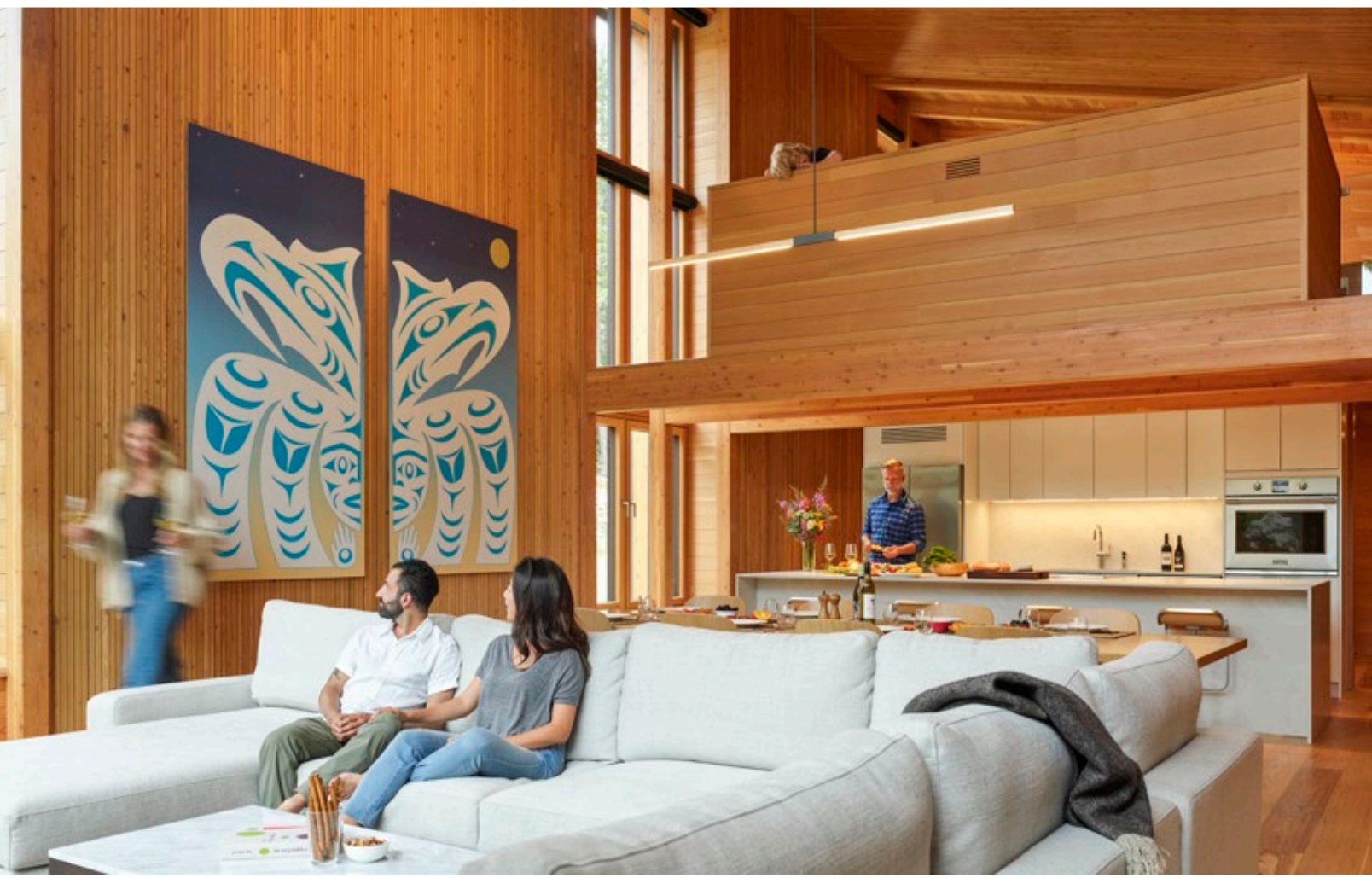
An innovative mass timber home elevates off-grid design

Soo Valley, B.C.

In the most recent *Wood Design & Building* Awards, SoLo was selected for a Merit award. (The Honor winners and a complete list of projects will be featured in our next issue.) Wood was chosen as this residence's primary structural material, resulting in a beyond net-zero carbon building. The wood is also exposed in its entirety throughout the home – a "temple to Douglas fir." While SoLo stands out as an exceptional example of sustainable construction in a challenging location, the wood structure also represents a key step in the development of larger buildings.

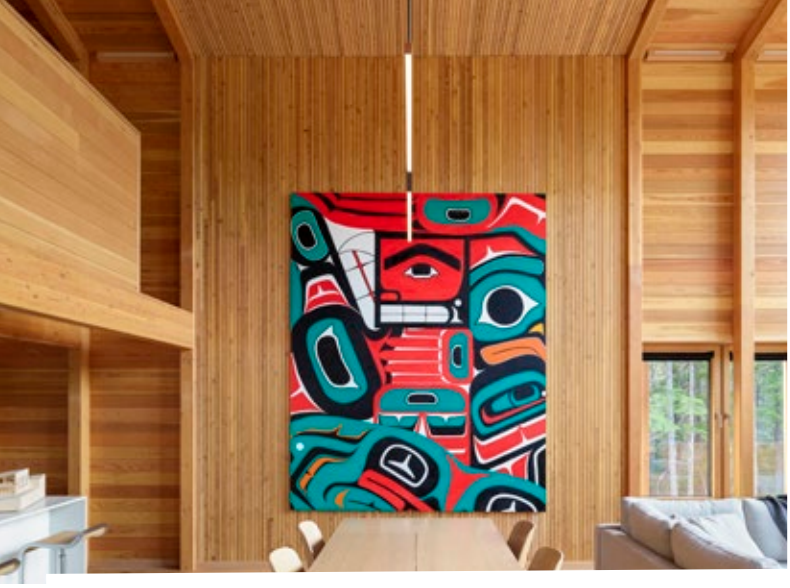
According to Perkins&Will, "We've taken lessons learned from SoLo around prefabrication and detailing of the panelized mass timber facade and are looking at ways to apply it to a system suitable for mid- and high-rise buildings." The 37-storey Canada's Earth Tower – a mixed-use landmark planned for Vancouver – is one of the projects the company has in mind.

"We are currently working with engineers and fabricators to develop a wood-based facade system that would work similar to other prefabricated facade systems, such as a curtainwall or precast concrete that attaches back to the main structure of the building. In this case, encapsulated mass timber would serve as the main structural element of the facade panels, resulting in a wood-based, low-carbon alternative with high thermal performance targets."



High thermal performance targets are part of what makes this home unique. Sited atop a forested knoll overlooking the spectacular Soo Valley, north of Whistler in British Columbia's Coast Mountains, SoLo is not a typical alpine home. With the client's intention to pioneer a future zero-emissions alpine community, Perkins&Will designed a prototype that demonstrates a unique approach to building off-grid in a remote environment, where every choice has consequences. It is also the firm's first Passive House–certified project. SoLo has earned the highest rating from EnerGuide, Canada's energy performance rating system, and exceeds Step 5 of the British Columbia Energy Step Code, indicating the highest level of energy efficiency in the province.

To minimize site disturbance, the modular prefabricated home was placed on a light structure above the uneven terrain, reinforcing its relationship to the site as a "visitor," allowing nature and the site to remain the focus. SoLo embodies a simple aesthetic through a restrained material palette and edited architectural features. The interior of the house features only six materials, with Douglas fir celebrated throughout as both structure and finish. As part of their commitment to promote health and well-being, the architects purposely eliminated the use of any harmful chemicals.



Solving the challenges provided by the site's remote location and seasonal construction window, local builders were commissioned to prefabricate the wooden modular building elements off-site. This was essential to allow for quick erection of the building in the summer season, while decreasing the amount of equipment and materials needed onsite – also reducing the project's embodied carbon footprint.

Given the valley's extreme climate, it was critical to have an "enclosure first" approach to ensure efficiency and outstanding comfort. Employing Passive House principles, the designers applied a two-layer approach to the enclosure. An outer heavy timber frame acts as a shield, resisting the weather, while the heavily insulated inner layer acts as the thermal barrier. The main house was encased in 2-ft.-thick insulation and sits independent of the large outer roof structure and surrounding steel platform. To ensure the house functions with exceptional thermal performance and air tightness, detailed thermal modeling was conducted for each weather condition. Even with the addition of double-height glazing to take advantage of the valley's views, the home has achieved PHI Low Energy Building certification.

To maintain the large north-facing window and open-concept design, the architects used an innovative structural solution that eliminated the need for wood shear walls. Introducing two tension-rod braced frames at each end allowed the frames to collect the seismic loads from the roof and enabled unobstructed views from the large feature window. The braced frames secure the roof, while the limited shear walls within are used to secure the house, creating two independent seismic systems.

As an "off-grid" home, several systems are required for the home's operational independence. With the goal to eliminate fossil fuels and combustion from its operation, power is provided by a photovoltaic array (mounted vertically on the south facade) and geo-exchange system coupled with hydrogen fuel cell for backup energy storage. The house collects and treats its own drinking water and processes its wastewater. The result is a beautiful and self-sufficient 4,090-sq.ft. house that generates more energy than it uses – beyond net zero energy. SoLo merges beauty and function, while optimizing the use of wood to achieve its goals.

ARCHITECT
Perkins&Will
Vancouver, BC

STRUCTURAL ENGINEER
Glotman Simpson
Vancouver, BC

GENERAL CONTRACTOR
Durfeld Constructors
Whistler, BC

PHOTOGRAPHY
Andrew Latreille
Vancouver, BC

MATERIALS

Frame
Glulam columns and beams, DLT bearing walls and roof with tension rod braced frames

Floor and roof systems
DLT, CLT and NLT

Interior partitioning
Lightwood frame stud walls

Walls and ceiling
DLT panels alternating with glulam columns and beams with horizontal siding infill walls

Flooring
Hickory engineered hardwood floor

Millwork
Painted MDF and plywood

Siding
Horizontal Douglas fir siding

Roofing
Standing seam metal

Windows/doors
Passive House–certified OPTIWIN window and door; Blackcomb triple-pane curtainwall system

Wood deck, finish
Sansin coating with KP-12 UVW

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Hotel Bauhofstrasse

This modular mass timber hotel exemplifies the spirit of urban renewal – and sustainable design

Ludwigsburg, Germany


Bergamo

Located in an urban area that had been neglected, the Hotel Bauhofstrasse is a transformative project in Ludwigsburg, a city less than 10 miles north of Stuttgart. The hotel was designed intentionally to fit in with the city's historical buildings, which inform the hotel's height and scale.

The exterior, covered in white Eternit plates, conceals the building's essential structure, which is primarily wood. Modules produced in Austria – using computer-cut CLT panels for walls, floors and ceilings – were installed onsite within five working days, comprising a total of 55 guest rooms. This technique bypassed the problematic issue of inclement weather, which could have had a negative effect on the construction timeline.

More importantly, this is the first carbon-neutral building in Ludwigsburg; every detail was considered in terms of efficiency and sustainability. The interior features exposed beech wood, creating a warm ambiance in the minimalistic spaces. Local craftsmen designed the solid ash bar, counters and tables, while the parquet flooring is made of the same wood.

Sited on a slope, the north-facing basement rooms take advantage of street access for services such as waste disposal, bicycle rentals and laundry delivery; together with the ground floor, this level forms a solid base for the prefabricated modules, while a concrete stairwell enhances stability.

More than 15,500 cu.ft. of locally produced wood used for the hotel's construction results in approximately 880 tons of CO_2 storage. Along with making a design statement, the architect's mission was to highlight the ease and efficiency of using sustainable materials, such as mass timber, to create a healthy, welcoming environment that can attract visitors for many years to come.

ARCHITECT
Von M
Stuttgart, Germany

STRUCTURAL ENGINEER
Merz Kley Partner
Dornbirn, Austria

WOOD CONSTRUCTION
Kaufmann Bausysteme GmbH
Reuthe, Austria

PHOTOGRAPHY
Brigida González
Stuttgart, Germany

QUICK FACTS

- A standard module consists of almost 255 cu.ft. of spruce
- Assembling each module (one room) took about four days, including drying time for cement-based screed and bathroom tiles
- Duration of construction in the factory was four weeks, including one week for setup
- All modules left production fully equipped, including windows, complete building technology and wool floor coverings
- The hotel consists of 42 room modules in eight different types, connected by metal joints that are decoupled with polymer soundproofing inlays
- A massive concrete slab above the ground floor allows an open-concept reception, bar and breakfast room
- On one day, 11 room modules were installed, taking approximately 30 minutes each

FUTURE PROJECTS

Von M is planning several wood-based buildings over the next few years, including:

- Grundschule Fuchshofstrasse, a new school in Ludwigsburg
- GWG Tübingen, a four-storey corporate headquarters for a real estate company
- Wohnungsbau Schauinsland, a residential complex in Ludwigsburg

Visit vonm.de for more information

Waugh Thistleton displayed the MultiPly modular maze at the 2018 London Design Festival IMAGES: Ed Reeve

A Modular Revolution

Mass timber enables a new generation of ready-to-assemble buildings

Joann Plockova

Modular construction is the talk of the industry these days. This offsite method, where components are prefabricated in a factory and then transported for onsite assembly, is the subject of recent reports including Arup's 2019 *Rethinking Timber Buildings*, which claimed the future is prefabricated, and McKinsey's 2019 *Modular Construction: From Projects to Products*, which notes that, "attracting an unprecedented wave of interest and investment," modular construction looks likely to disrupt the building industry. Modular is also topping trend lists. Think Wood's *Timber is Trending: 6 Trends to Watch in 2020* put prefabrication and modular technologies at number two. Modular is on the agenda at conferences including *Why Modular and Why Now? The Case for Modular Construction in a Post- Pandemic World* at the 2020 IWBC (Industrialized Wood-Based Construction Conference). Their Offsite News noted that by 2021, the Modular Building Institute predicts that five percent of all new builds will be modular.

During a presentation at IWBC, Craig Mitchell – the principal of Vancouver-based modular construction and consulting firm Black Box Modular Solutions – said, "We are truly at a tipping point." Mitchell was speaking to the new sense of urgency that modular has taken on as a result of climate change, the housing crisis and the COVID-19 pandemic. It's this sense of urgency and other drivers – including the evolution of technologies, labor shortages for onsite construction and a heightened need for safety – that are putting modular front of mind for the industry and pushing it forward from housing to hospitality to healthcare. Relatively lightweight and easy to assemble, versatile and flexible, mass timber is becoming a modular material of choice.

"Besides the environmental benefits of carbon sequestration and optimization of wood waste, building in a controlled environment de-risks many construction projects," Mitchell explains. "[Advantages include] cost certainty of the components – as many design decisions and purchasing decisions have to be made up front – schedule certainty and quality certainty."

Europe – long appreciative of the many benefits that modular construction offers, including faster delivery, controlled costs and higher quality – is at the forefront of mass timber modular construction. The Urban Village Project, a collaboration between Space10 (Ikea's global research and design lab) and Copenhagen's Effekt Architects, is described as a vision for how to design, build and share our future homes, neighborhoods and cities; it is based on a modular building system that is prefabricated and as easy to disassemble as assemble, allowing for a variety of housing typologies.

"The architecture of the Urban Village Project would be based on a standardized modular building system and made out of cross-laminated timber – a wood that comes with huge environmental advantages and outperforms steel and concrete on multiple levels," Space10 says. "It's also been proven that living in buildings made of wood creates better health and well-being for people. The modular system can be used to build everything from townhouses to high rises, from single-person homes to spaces that house several loved ones under the same roof."

In Austria, architect Chris Precht is proving that modular doesn't have to mean mundane. Rising 18 storeys and 62 m high, the Toronto Tree Tower – a mixed-use residential building inspired by Israeli-Canadian architect Moshe Safdie's Habitat 67 – stacks modules assembled offsite from prefabricated and precut CLT, clad in timber and featuring trees on every terrace. "The building should be seen as a catalyst for future residential buildings that are 'more efficient to construct' and 'more ecological to our environment' than common construction methods," Precht states on his website. Since the concept was announced several years ago, there have not been updates on whether this project will be built.

Model-C – Generate– Interior

Waugh Thistleton Orsman Rd Site IMAGE: Tim Crocker

The Urban Village Project IMAGE: Effekt Architects for Space10/Ikea

Community social hub IMAGE: Effekt Architects for Space10/Ikea

One of Precht's more recent projects is Bert. Conceived as a modular building system, this playful, treehouse-inspired "family of modular houses" is comprised of parts prefabricated offsite. New modules can add both length and width to the imaginative design.

"Precision and speed are the benefits of prefabrication," Precht shared on his Instagram account in response to the recent realization of Bert in the forests of Austria. "It still needs skilled craftsmanship to pull it off. Such a satisfying process to give life to Bert."

In the U.K., Waugh Thistleton has been leading the pack in timber design and construction, while proving the power of mass timber to help with the housing crisis. Set to bring 65 affordable homes to a brownfield site in east London, Watts Grove will mark the U.K.'s first mid-rise CLT modular scheme.

"CLT modular is a great solution for all housing," says Andrew Waugh, the firm's co-founder. "It provides high quality, safe, warm, solid, acoustically protected, airtight housing at an affordable price. The process of manufacture and construction is fast, lower waste, lower energy and better working conditions."

Modules made from sustainably sourced CLT will be constructed in a factory in Basildon, where units will be furnished with kitchens, bathrooms, finishes and fittings before onsite installation. The team expects the project to be constructed in 50 percent less time, at a cost savings of 10 percent.

The American Institute of Architects' (AIA) Design for Modular Construction: An Introduction for Architects guide notes, "Increasingly urgent demand in the housing, hospitality and healthcare markets is also driving more projects to use modular construction. As many cities across the country are experiencing severe housing shortages, modular construction – with its potential to significantly increase the speed of delivery, while also providing opportunities for cost savings – is seen as a strategy that's particularly well-suited to address the issue."

In Canada, B.C. Housing has built over 2,000 units employing modular construction under its Rapid Response program for people experiencing homelessness across several municipalities. Ontario is just getting started on a similar strategy.

"You will start seeing more and more high-performance modular projects come on-stream [with the updated International

Building Code]," says Mitchell. "Soon, building offsite will gain greater traction as the performance standards increase and it becomes easier to build in controlled settings. If we look at what is going on in the rest of the world, automation and robotics are the next steps for modular here in North America. Combining BIM and digital design, many of the processes can be computer modeled, which will lend themselves to driving down costs and increasing output."

Although North America is behind Europe in embracing advanced modular construction technologies, upcoming projects are proving that the continent is taking steps to catch up. Set to comprise 14 residential units and an affordable, co-working space for the community on the ground floor, a new five-storey apartment block will mark Boston's first full CLT "kit of parts" Passive House. Initiated by Generate, a new Boston-based architectural technology company founded by architect and MIT researcher John Klein – who has partnered with development, design and construction company, Placetailor – the project will be the first to employ Generate's Model-C, which is among the firm's catalogue of tech-enabled and replicable kit-of-parts building solutions that utilize mass timber. The firm is also exploring the potential to use this system for buildings up to 18 storeys tall.

"By replacing conventional concrete and steel construction materials (which significantly contribute to the release of carbon dioxide into the atmosphere), the Model-C system functions instead as a carbon sink, storing the carbon in the timber of the CLT cellular structure and envelope over the building's lifetime," states an abstract about the Generate project. The system includes a CLT roof canopy and modular bathroom pods that are all prefabricated offsite. The CLT will be supplied by Nordic Structures, in Quebec; construction begins this spring.

No longer limited to boring building bricks, new advancements in technology offer flexibility and variability in the modules that designers and architects can create, while ensuring precision and productivity in manufacturing.

"New tools and strategies are regularly emerging, fostering an ongoing evolution in the way we design and construct buildings," wrote the AIA in Design for Modular Construction. "Technologies such as robotics, sensors, cloud computing and virtual reality are enabling project teams to pursue ever more ambitious and complex goals."

BC Housing used modular construction in its Rapid Response Program IMAGE: Metric Modular

This will be the first project to implement the Model-C modular system developed by Boston-based firm Generate, working with Placetailor IMAGE: Forbes Massie Studio

Beyond housing, hospitals and classrooms, modular is making its way into other markets, including what is being touted as the world's first prefabricated CLT concert hall in Nuremburg, Germany.

"The entire building is designed as an engineered timber monolith, only consisting of repeating timber modules," states architect Stephen Markus Albrecht, who teamed up with architect Gilles Retsin. "In a digital workflow, these modular, Lego-like elements are prefabricated in a factory setting, using large CNC-machines and are then shipped to the site for quick assembly. The building is entirely based on a repeating V-shaped timber section of 3 m width by 1.2 m depth."

Part of our built environment's past, modular construction – in combination with mass timber – looks rife to set a precedent in the 21st century and beyond. As a prefabricated product, mass timber is a natural fit for this growing movement.

With support from revised building codes, the ongoing advancement of technologies and new materials and a sense of urgency for today's pressing issues, modular construction is being pushed beyond mere units to a systematic solution that has the potential to bring a sea of change to the industry.

Figure 1: Katerra Timber-Timber Composite Rib Panel being installed

CASE STUDY
The Catalyst Building by Katerra

Providing flexible timber solutions for commercial long-span floor and roof applications

Hans-Erik Blomgren, PE, SE, P.Eng., Struct.Eng.

INTRODUCTION

The application of CLT panels as floor and roof structures for commercial buildings in North America is advancing rapidly, driven by the aesthetic appeal of exposed wood, faster construction times and carbon storage benefits. But the gap between market interest and defined market solutions often can be significant. In order to be competitive in the marketplace compared to established concrete and steel options, the CLT architect and engineer are challenged to bring a high level of optimization to floor plate designs that reduce cost without compromising structural, acoustic or fire performance. This is especially the case for open office and education buildings, where the program requires floor spans between column lines that are larger than traditional timber framing approaches can efficiently achieve.

BACKGROUND: CLT FLOOR & ROOF SPANS

Katerra opened the highest-capacity CLT factory in the U.S. in 2019 and began delivering CLT for use as floors and roofs on multi-family residential projects and office buildings. For typical multi-family buildings, CLT spans ranging from 12–20 ft. are required; for this project type, three- or five-ply Katerra CLT panels are well suited to span between bearing walls; however, Katerra's first office and education mixed-use building, the Catalyst Building in Eastern Washington State, required a 30-ft. floor span between column lines. A CLT flat panel is not capable of spanning this distance, even when increased in thickness to seven- or nine-ply.

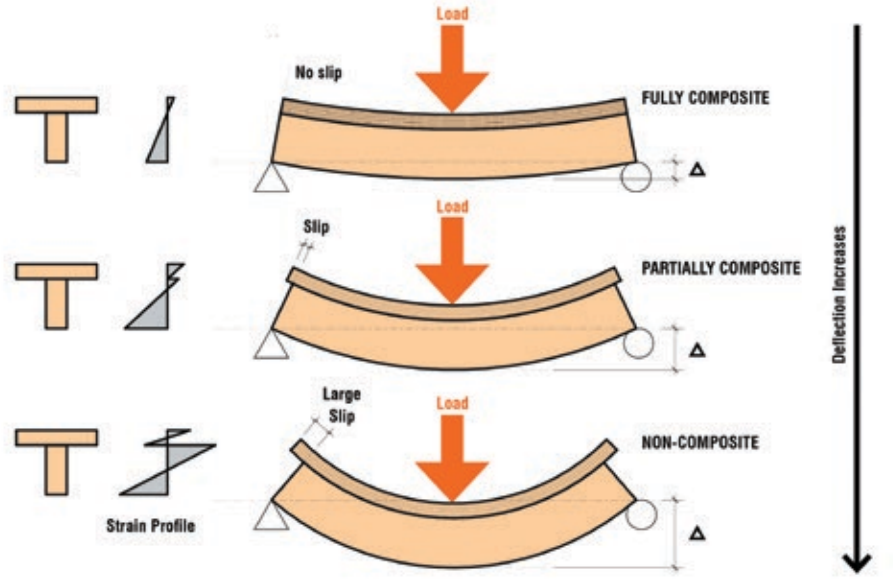

Figure 2: The timber-timber composite action increases the strength and stiffness by up to a factor of four

RIB PANELS DEFINED

Posed with this challenge, along with a desire to maximize the use of its CLT product, Katerra saw an opportunity to increase the span of its product beyond 20 ft. by introducing glulam beams or "ribs" to the underside of each panel, spanning parallel with its long (strong) direction (Figure 1). The efficiency of the resulting product is achieved when a rigid and strong structural connection between the CLT and glulam ribs is provided, which enables the full cross-section to work compositely.

Calculations demonstrate the strength and stiffness of a rib panel can increase nearly four-fold when full composite action is achieved (Figure 2). This optimized use of wood fiber is the primary advantage of a rib panel. As an example, the Catalyst Building rib panel has a span-to-depth ratio of 15.5:1, which is equivalent to a benchmark composite steel floor beam for the same span and load, while being 40 percent lighter in weight. It is clear to see the potential rib panel products have to expand mass timber floor spans well beyond the 20-ft. limit of five-ply (Figure 3).

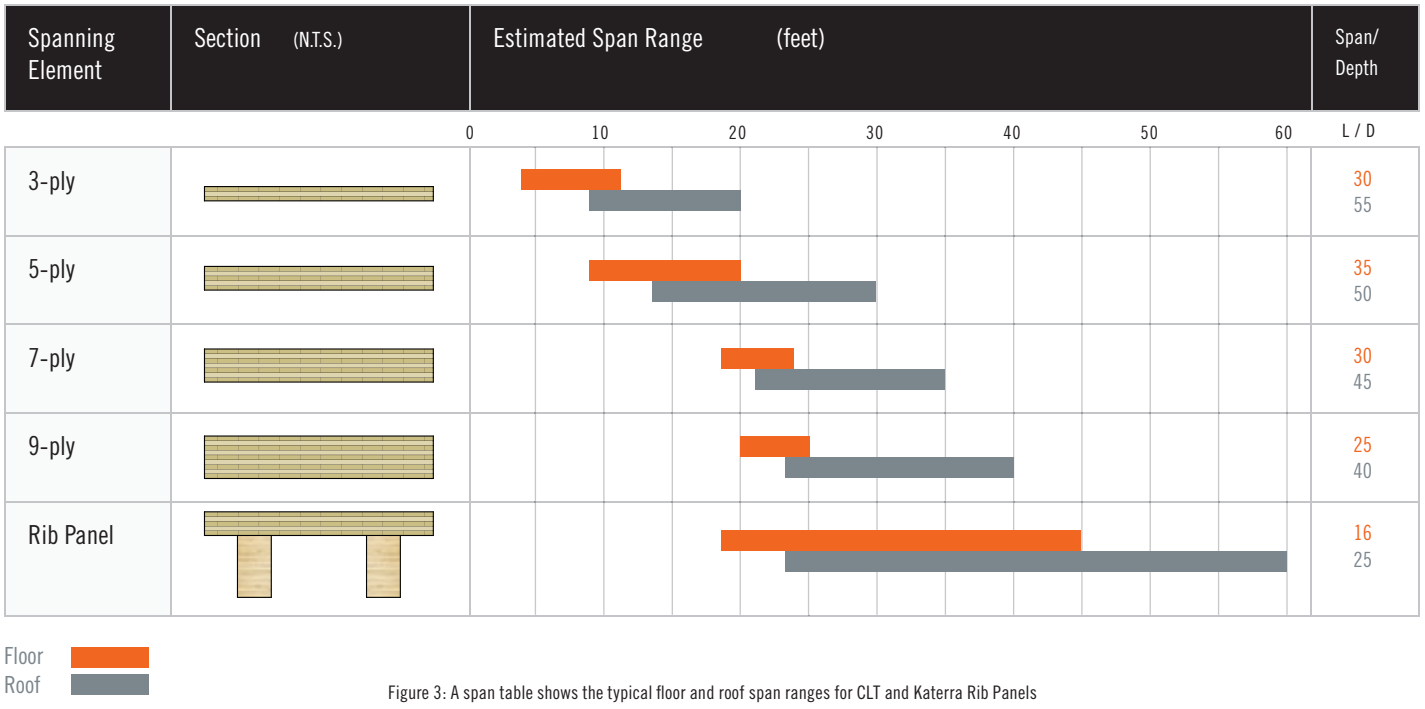

Figure 3: A span table shows the typical floor and roof span ranges for CLT and Katerra Rib Panels

PRODUCT DEVELOPMENT

With the project benefits of the rib panel identified, Katerra's engineers and manufacturing team began a product development effort to define the most suitable materials, method and process of compositely fastening glulam ribs to the underside of CLT. The selected connection method is achieved by: 1) applying an adhesive to the top of each rib; 2) laying the CLT panel on top; and 3) installing partially threaded screws through the joint to clamp the surfaces closely together and to spread out the adhesive, covering the full surface area of the mated parts (Figure 4). This process has been dubbed the "Screw-Press-Glue" method and has undergone prior research and testing in Europe [1]. The resulting manufacturing process allows for a rib panel to be fully assembled in less than 20 minutes (Figure 5). The production for the Catalyst Building was able to stay ahead of the construction site schedule by producing up to 18 30x10-ft. rib panels in a single factory shift.

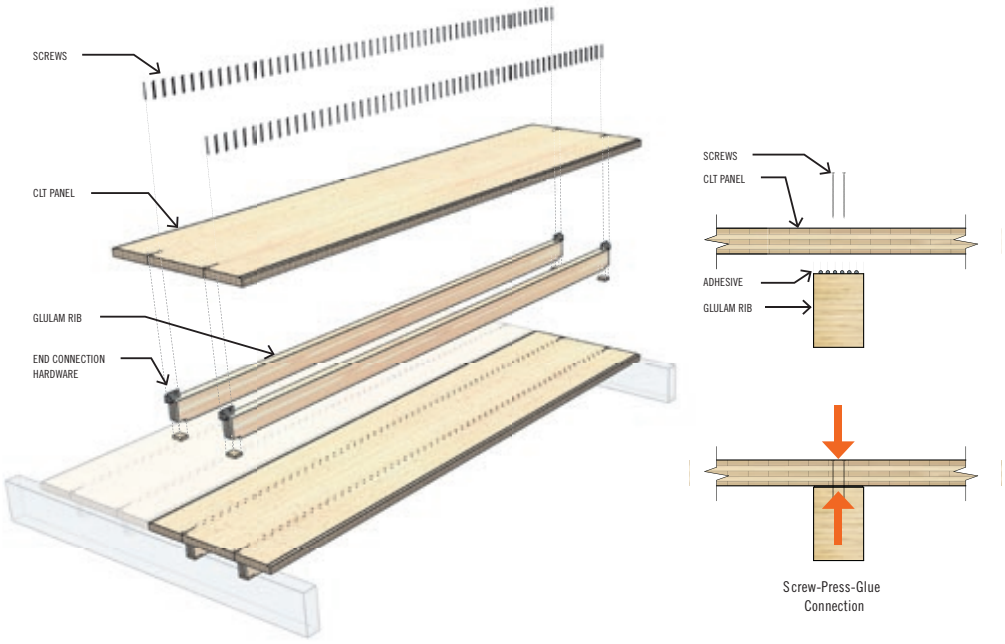

Figure 4: Exploded view of the Katerra Rib Panel components and assembly steps

Figure 5: Katerra Rib Panels being factory assembled using the Screw-Press-Glue process

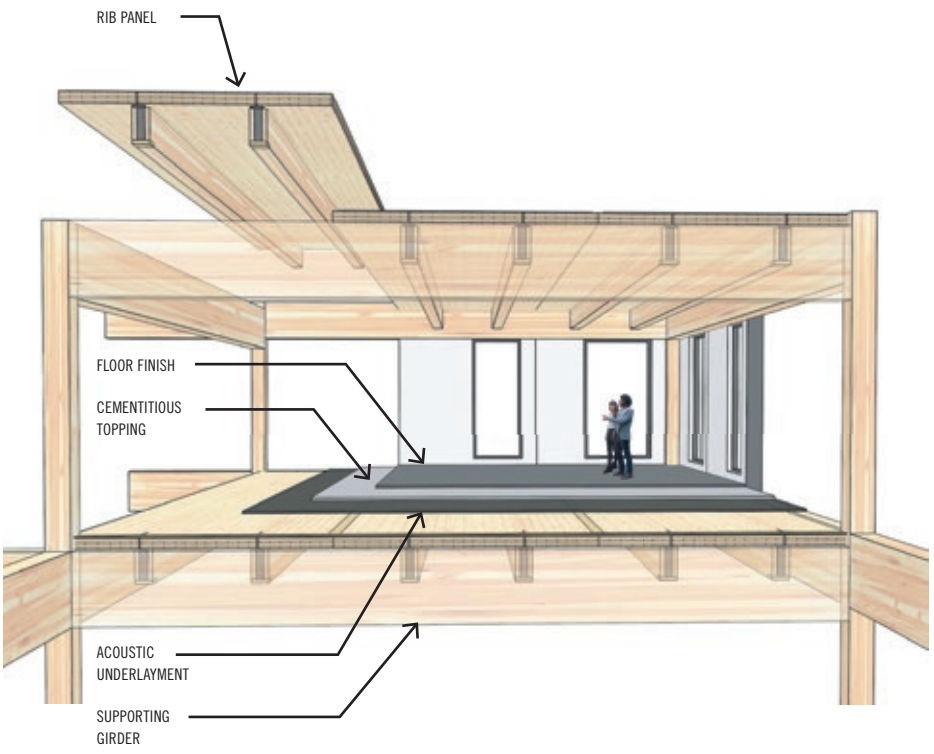

Figure 6: Katerra Rib Panel topping assembly for the Catalyst Building

BUILDING DESIGN INTEGRATION

The five-storey, 150,000-sq.ft. Catalyst Building provided a valuable "real project" opportunity to ensure the rib panel product design is integrated with the architectural and building operations requirements. To achieve the overall acoustic sound transmission requirements through the floor plate and limit human footfall vibration perceptibility to acceptable levels, a minimal 2-in.-thick gypcrete topping mass and acoustic underlayment were placed on top of the CLT (Figure 6). The CLT panels transfer horizontal wind and seismic diaphragm forces directly, which allowed the topping materials to be non-structural. The rib panel was designed for a one-hour fire resistive rating through charring of the exposed CLT and glulam surfaces; this exceeded the minimum requirements of the Catalyst Building Type IV Heavy Timber Construction Type.

The void space between each rib provides ample room for building services, including conduit, sprinkler pipes, lighting and small ductwork to route above the bottom elevation of the ribs (Figure 7). In certain locations, a 4-in.-diameter horizontal penetration through the ribs was provided for sprinkler lines running transverse to the rib panel span direction.

Figure 7: Catalyst floor plates prior to tenant fit-out

Figure 8: Full-scale destructive testing at Oregon State University

CODE ACCEPTANCE

The Catalyst Building is a first-of-its-kind application of rib panels in the U.S. The project was designed and permitted under the 2015 International Building Code. Materials and methods of design for timber-timber composite members are not prescribed in the code. Recognizing this, Katerra engineers worked with the building official to ensure that full-scale destructive load testing would be acceptable to demonstrate rib panels are safe (Figure 8). It is worth noting, this testing was performed to recognized standards to help ensure the acceptance of rib panels on future projects in different regions of North America. Table 1 provides a summary of the code compliance design criteria that were satisfied. More technical details regarding rib panel product testing can be found in Katerra's 2020 World Conference on Timber Engineering paper [2].

Item	Requirement	Reference
Construction Type	IV (HT [a])	IBC 602.4
Strength	Testing [b]	IBC 1604.7
Creep	Testing [b]	IBC 1604.7
Span / Depth	15.5	-
Total Deflection	L / 360	IBC 1604.3
LL Deflection	L / 480	IBC 1604.3
Footfall Vibration	R = 10 [c]	CCIP-016 [3]
Fire	1 hr / HT	NDS Ch. 16
Acoustics	STC 50 [d] IIC 45 [d]	ASTM E90 ASTM E492
CLT Grade	V2	APA PRG-320
Glulam Grade	Spruce-L. Pine 20f-EX	CSA-086

[a] The rib panel CLT, glulam, and end connections satisfy IBC Heavy Timber (HT) requirements.

[b] Superimposed load-carrying capacity determined from preconstruction load testing in IBC Section 1709.

[c] Response factor (R), equivalent to 0.5%g accelearation limit for office,with field testing verification.

[d] Lab test values. Acoustic performance has been verified with field testing.

Table 1: Catalyst Building rib panel design criteria summary

Figure 9: The Catalyst Building in Spokane, WA.

CONCLUSION

The Katerra Rib Panel has been developed to provide an efficient solution to increase the span capability of CLT floors in commercial building applications. The rib panel span, size and cross-section dimension are readily customizable for a creative variety of project-specific applications. The manufacturing process and performance of the product has been demonstrated on the Catalyst for a 30-ft. span. Performance has been validated through full-scale destructive and non-destructive testing to recognized standards. This validation can be used as justification for code acceptance on future projects.

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[1] Bratulic K. et al.: Investigations Concerning Screw-Press-Gluing of Assemblies with CLT, INTER 52-18-01, 2019.

[2] Blomgren H. – Development Testing and Application of Mass Timber Composite Rib Floor Panels for Office Buildings, World Conference of Timber Engineering, 2020.

[3] CCIP-016 A Design Guide for Footfall Induced Vibration of Structures, M R Willford, The Concrete Centre, 2007.

About the author

Hans-Erik Blomgren manages the development and certification for Katerra's cross-laminated timber product line manufactured at a 270,000-sq.ft. factory in Spokane Valley, WA. As well, he leads Katerra's efforts to technically justify and test cross-laminated timber panel assemblies and systems for code compliant fire, structural and acoustic use. Hans-Erik represents Katerra on the APA PRG 320 Cross-Laminated Timber and American Wood Council Wood Design Standards code development committees.

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Hayward Field, University of Oregon.
SRG Partnership Architects, Photography © Kevin Scott

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Wood WARE

A Natural *Woodworker*

When Mateo Bucher was five, he started helping his dad – a cabinet maker – in his workshop, and he's been there almost every day since. In 2017, Mateo's dad bought him a lathe. He watched YouTube videos to learn how to turn small items. A local woodturner taught him how to shape a bowl.

At only nine years old, Mateo launched his business, As It Turns Out. He started taking his bowls, spinning tops and rolling pins to artisan markets, selling out by the end of the day and going home with a list of orders. Now 13, Mateo spends about three hours a day turning wood. There is nowhere else he'd rather be.

"I love taking a raw material that nature gave us and giving it a second life. It is really fun when you have those shavings flying," says the Nelson, B.C., teen, who is considering becoming a professional woodturner, woodworker or arborist when he grows up – as long as it involves wood.

Mateo recently set up a website, teowoodworks.ca, to sell his work and added new items, including honey dippers and pens, as well as custom work, such as knobs and door handles.

"There has been a lot of traffic," he says. "It's a great feeling to know that people are interested in what you make."

And what has Mateo done with his earnings so far? He bought himself a professional lathe, of course. —*Abigail Cukier*

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We have a rich history of innovation and quality, all fueled by a passion for materials, a love for design and a commitment to service. For every member of our team, it's personal.

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→ Salt River First Nation Community Facility
Fort Smith, Northwest Territories